Enterprise GIS for Municipalities – An Integrated Approach

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ABSTRACT

The efficacy of a GIS system is better understood and utilized when the solution starts functioning at an Enterprise level. An enterprise GIS solution is the need of the hour taking into consideration the voluminous information that needs to be made available to various decision makers in various departments. Enterprise GIS provides a road map for municipalities planning to implement a structured GIS system.

1. INTRODUCTION

Geographical Information System (GIS) technology provides municipal governments with extraordinary quantitative and qualitative benefits. In fact, the technology can be the basis for revolutionizing how government processes work. Some of these benefits and changes can be achieved fairly early in the GIS development process; while others take much longer to realize. A GIS may take several months to develop and the full benefits are experienced after many years. The *time requirement* is only partly what is required to build a database and procure a system. *Technology transfer and capacity building for effective utilisation of the system,* and perhaps more importantly, *synergising existing work processes* can be as complicated as the development of the system itself.

A comprehensive municipal GIS should provide a common platform for data collection, storage, authorized and secure access to spatial and aspatial data, harmonize the work flow of respective departments and disseminate information for the benefit of public at large. Municipal GIS will largely address the needs of various local government departments such as Local Administration, Public Works & Engineering department, Public Health Department, Water supply, Town and Country planning Department, Public Safety, Land records, Tourism Department *etc*.

The subsequent sections enumerate the need for a municipal GIS solution for various departments, suggested approach for implementing a system, Enterprise GIS approach to municipal GIS, successful case studies implemented by Magnasoft for municipal GIS, hurdles for making municipal GIS a success and the future road map for municipal GIS in India

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2. MUNICIPAL GIS – A STRUCTURED APPROACH

This section touches upon the specific needs that need to be addressed by a Municipal GIS system. Each department at the municipal or panchayat level have specific requirements for spatial and aspatial data and often, there is an overlap of information crucial to these departments. An Enterprise approach enables access to information across multiple departments apart from bringing in greater efficiency, speedy decision-making and transparency in the functioning. The needs of each department are hereby explained in brief. The requirements, from a department and enterprise perspective, are only indicative and not exhaustive (which is outside the scope of this document).

User Needs Assessment

A needs assessment is the first step in implementing a successful GIS within any municipal organisation. A needs assessment is a systematic look at how departments function and what spatial they need to complete work. In addition to the final needs assessment report that is generated, intangible benefits are realised by going through the process. Conducting a GIS needs assessment fosters cooperation and communication among departments by working together on a common technology and new set of tools. In addition, the needs assessment activity itself serves as a learning tool, because potential users in each participating section gain understanding about GIS concepts and how the technology can best serve the various departments.

Computerization involves design, creation, implementation and maintenance of a stable spatial database linked to the database, which will be used on a day-to-day basis. The whole process is continuous and not static. A sample of the spatial and attribute data that need to be collected and collated is shown in Table 1.

Spatial and Attribute data	Local Administration	Public works & Engineering	Health	Civic amenities	Town and Country Planning	Land Records
Administrative Boundaries (State, District, Mandal, Village)	X	**X**	**X**	**X**	**X**	X
Road Network (Highways & Other Roads)	X	X		X		**X**
Railroads	X			**X**		**X**
Sewerage & Storm water Network		**X**		**X**		
Water bodies	X	**X**	**X**			
Bridges	X					
Landmarks	X			**X**		
Demographic & socio-economic data			**X**			
Electricity & underground cable networks				**X**		
Public Health Centers, hospitals, emergency relief units, epidemic			**X**			

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zones						
Temperature, rainfall, soil and land use data			**X**			
Local Transportation						
Political map						**X**
Landuse				**X**		**X**

3. ENTERPRISE GIS PLAN FOR MUNICIPALITIES

Planning and management of urban and rural areas generally occur by departments, with each department having its own database. By focussing only on selected areas or realms of the municipal jurisdiction, individual applications i.e., project-based, have created significant problems in many areas where GIS was not a successful tool; thus narrowing down the scope of GIS. For instance, when decision-making elements of the local government want to use multi-agency, GIS-derived information, it is often difficult to integrate data.

GIS as a micro-level planning tool can be effectively integrated into the decision-making process only if the data sharing, both spatial and aspatial data is accessible across all departments.

Enterprise GIS model for municipal planning can be best described as a series of activities that focus on common GIS requirements of participating public and private organizations. From those requirements, a common set of spatial data can be defined.

Activities that identify commonalties among various sectors and that are critical to the implementation of an Enterprise GIS are:

- Organization – Structure inter-agency managerial and technical committees
- Familiarization – Orient local government agencies with the advantages of shared GIS resources, especially survey, inventory and base mapping.
- Pilot Studies – Conduct Pilot studies to determine organizational responsibilities
- Standardization (Metadata) – Establish common procedures for defining GIS applications and data
- Co-operation – Setup mechanisms for agency interaction and communication
- Base Mapping – Develop a common base map for all sectors
- Data Sharing – Ensure data are shared and duplication minimized
- Applications – Identify applications that encourage inter-agency co-operation
- Training – Establish training facilities that support all agencies

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Conceptualization of an Enterprise Municipal GIS Solution

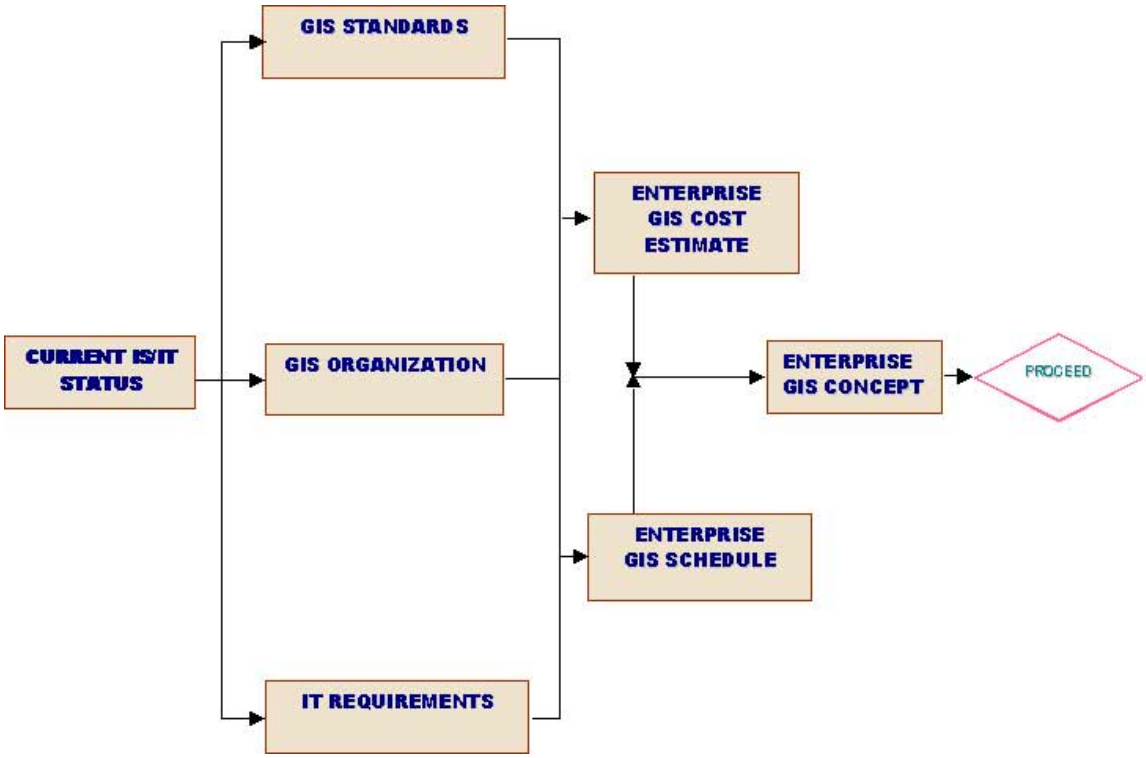

Figure 1. Enterprise Municipal GIS

Steps involved:

- Enterprise GIS requires both Local Area Networks (LAN) and Wide Area Networks (WAN) to be operational
  - If the communication infrastructure is not in place, the cost of the system will have to include expenditures for developing the physical communications network
- Standardizing methods and formats involved
  - User need assessment and preparation of data dictionary of participating agencies
- Incorporation of a framework for utilization and management of the Enterprise GIS and initial assessment of the information technology (IT), including hardware, software, and personnel training should be conducted.
- Preliminary costing and development of a schedule for implementing an Enterprise GIS.
- Report preparation on the application and advantages of Enterprise GIS at the micro level and macro level in the specific urban and rural environment.
- Implementation of Enterprise GIS
- The Enterprise GIS will answer the following questions for the decision makers:
  - What critical information needs will be met?
  - Will the technological environment support Enterprise GIS?
  - What are the available resources – financial, personnel, and IS/IT?
  - How integrated is it in providing holistic information for the decision makers
  - Data Security and Data integrity at the same time dissemination of information

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- How transparent is it in providing information to Public at large?

4. MUNICIPAL GIS IN INDIA– HURDLES

Few of the critical issues typically faced by GIS solutions providers for Municipal Corporations in India are as follows:-

- Government restrictions on the Survey of India map data for large portions of India
- Lack of reliable and accurate digital data
- No proper Government policies/guidelines to address these issues
- Private sector companies creating digital maps need to get clearance certificates from the Ministry of Defence, which is invariably treated on a case-to-case basis and is time consuming and does not take into consideration changes in spatial and attribute data in the interim.
- Lack of standards to assess GIS data quality and hence improper evaluation of data providers
- Need for the Municipal corporations to devise strict guidelines for acceptance on quality and credentials of the solutions provider, and not merely selection of the lowest priced vendor
- Low awareness of benefits of GIS
- No outlined government policy
- Lack of funds to support GIS solutions at the state and local government level
- Need for proper allocation of funds

5. SELECTED CASE STUDIES OF MAGNASOFT

Property Enumeration and Mapping of Ward 76 Bangalore

Background and Objectives

BMP is the Municipal Corporation of Bangalore City responsible for administering all engineering, health and revenue activities. The city is divided into various wards based on locality for efficient functioning. The project area was 4.9 sq kms covering Ward 76, which represents the prime area of the city with highest revenue collection. The objectives of the project were:

- Development of a model city programme with a real world situation to formulate and develop a geographic and management information system for improving the corporation administration
- Development of database template by collecting and digitising all property tax assessment registers
- Augmentation through well-planned and managed field surveys along with preparation of notational property maps

Key Aspects of the Project

- Played a vital role in the reassessment strategy by easy classification of property depending on landuse, type of construction, floor level of unit, neighbourhood, area and front/back street accessibility
- Significantly improved the ability of BCC officials to defend assessments from taxpayer challenges
- Systematic planning for cost-effective infrastructure investment and improved service provision & maintenance

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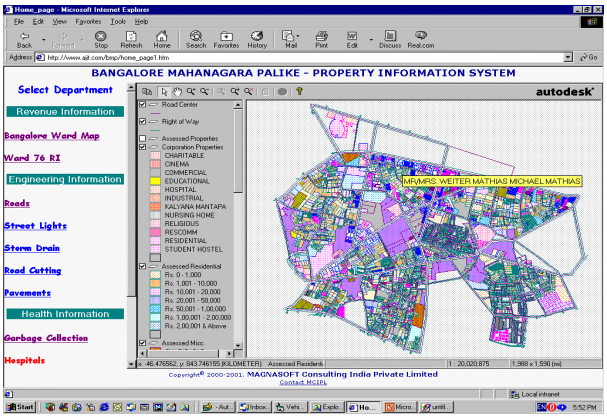
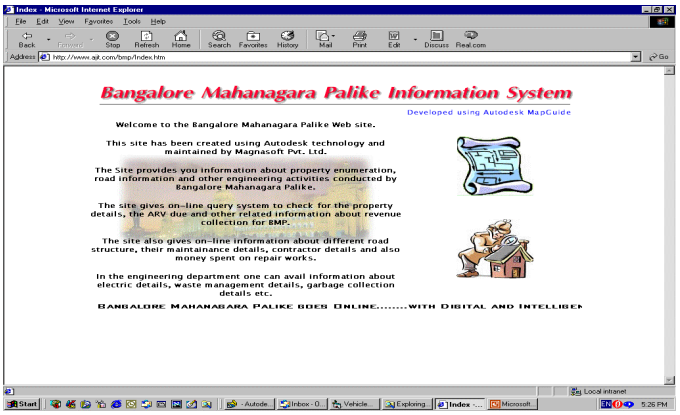
- Tax enhancement projections

Services Rendered and Methodology

- Computerisation of tax records
- Creation of base map:
  - Creation of base map at 1:7000 scale
- Creation of rough field maps and preparation of questionnaires for property enumeration
- Property enumeration and field survey
  - Marking of properties on base map
  - Matching tax records on the site and indicating property ID on the marked properties
  - Classification of properties based on land use such as residential, commercial etc.
  - Cross verification of survey data for authentication



- Database design and development
- Development of a web-based geographical and management information system by linking property maps with the database to help in property assessment and improve revenue generation.



  - Porting the property maps & database on Autodesk MapGuide server
  - Authoring of the ported data defining accessibility, display, and analysis & report generation privileges to the end user
  - Preparing user-friendly front-end application on MapGuide to work on Internet browsers

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Analytical capabilities included:

- Identification of property land-use according to residential and commercial establishments
- Determination of assessed and unassessed properties
- Trend of rental/self owned properties
- Total collection of revenue cross-linked to BMP database
- Total tax collection projected based on increase in no. of assesses, existing tax paid and rationalizing the taxation structure

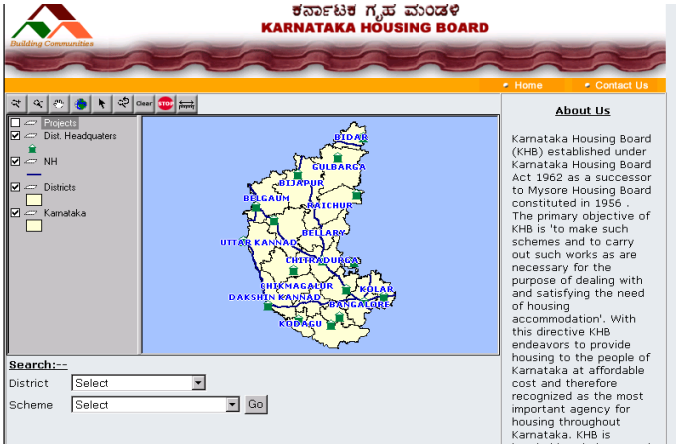
Tools and Methods Used

- MS Excel & MS Access database
- Visual Basic for GUI
- AutoCAD Map 2000 and MapGuide for GIS

Management Information System for Karnataka Housing Board

Background and Objectives

Karnataka Housing Board (KHB) is a statutory State Government of Karnataka undertaking, established in 1962. KHB has its presence in the State through a wide network of Project Offices. It has developed and implemented many prestigious housing projects throughout the State, providing housing accommodations to many.



The objective of the project was to develop a Management Information System for KHB, which caters to the various needs of the Site Users. The KHB MIS provides a solution that has facility to view Project specific information on maps using GIS mapping tools. The Property related data is maintained by KHB, whereas the Applicant data is maintained by CCSL (Canbank Computer Services Ltd., IT solutions and banking services providers for housing projects undertaken by KHB). Synchronization between both the databases takes place to reflect changes made in Property and Applicant data.

Key Aspects of the Project

- The system provides the facility to view property related information on maps
- The entire property related part for each project handled by KHB is maintained by the new system
- The system communicates with CCSL database to get applicant related information which is updated by CCSL application for property status and registration number.

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- The system with a new user interface proides a new look and feel
- Provides the facility to manage users and user groups
- Provides the facility to view deviations in the plans in textual format and on the map
- The system provides the facility to generate reports

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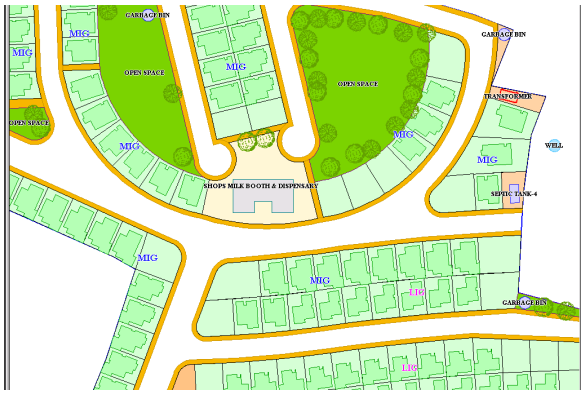
Services Rendered and Methodology

- Digitisation
- Phase I Web Application Development
    - Functionalities :
        - Viewing of project information on maps – state map, district map, location/key plan, layout/site plan, floor plan
        - Basic map functionalities – pan, zoom, display etc.
        - Application status
        - Account information
        - Property status updation

- Upgrading existing KHB website
- Phase II Web Application Development (for KHB administration and operators)
    - User management
    - Uploading
    - Deviation information
    - Reporting
    - Auction information



Tools and Methods Used

- AutoCAD Map 2000
- Autodesk MapGuide Server 6.0
- MS SQL Server 2000
- PHP 4.0
- Internet Information Server 5.0

6. MUNICIPAL GIS – FUTURE IN INDIA

According to estimates, India has more than 350 major cities. Hence, the market potential of GIS for municipalities is definitely huge. GIS helps spatial planning and decision making a reality at the Municipality level. Government departments are in constant need for spatial data for planning and implementation, and the use of geographic data undoubtedly is a vital asset for decision-making. However, the establishment of proper policies by the Government with regard to digital data creation and dissemination would go a long way in increasing the growth potential of the GIS industry in India. Also, the involvement of the private sector in consulting and system integration

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requirements, in addition to basic activities such as data capture and data conversion would propel the industry to higher levels.

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